

pronounce finally upon the prospects of this process," he says (p. 158), "we shall not find this quite an easy task. A few years ago English alkali-makers had such a high opinion of that process that no new vitriol chambers were built, and the question was discussed whether it was more worth while to work down the existing chambers, or to defray the cost of the new plant at once. Afterwards a less sanguine opinion gained ground, and it seemed as if Hargreaves's process would again be put into the background." At the present moment the writer believes that the outlook for the Hargreaves process is more favourable than ever.

Chapters V. and XII., on the Cost of producing Sulphate and Soda-ash, can only serve to give an approximate idea of the matter. The exact cost involved is not readily imparted by manufacturers, and is moreover governed by local circumstances, such as the current price of labour, &c.

The latter half of the volume is concerned with the second stage in the manufacture of alkali known as the black ash process. In this the salt-cake is heated with limestone and coal, the resulting carbonate of soda being removed by lixiviation from the insoluble alkali makers' waste. The first part of the chapter on Hand Furnaces appears to be very complete, and the figures on the plate facing p. 386 are correct and well-drawn. This can hardly be said of that portion relating to the modern revolving furnaces, this is probably the weakest part of the book, the author having apparently had no practical experience on this point. Figures of two revolvers are given; of these Fig. 182 may be said to represent a fairly good design, though one single wide evaporating pan is considered more convenient for repairs than two narrow ones. As regards the speed of revolution (p. 411) Dr. Lunge is a little out. He says the revolver gearing must be capable of giving speeds of one revolution in four minutes to five revolutions in one minute, "usually the highest velocity does not exceed one revolution per minute." Those figures are not correct for the present style of working. Revolvers should be able to go a good deal slower, but speeds as high as seven to eight revolutions per minute should always be possible, especially when working the Pechiney-Weldon process, when the after charge has to be very well and rapidly mixed through the rest. This can hardly be obtained when the large spin-wheel on the revolver is worked from a worm-wheel as Dr. Lunge describes, a pinion-wheel should be used. The author (p. 406) says, "Leaving aside the older constructions of revolving furnaces, we shall only describe two of the most modern." The first of these has been spoken of above; the second, figured pp. 414 and 415, a revolver fired by gas, was erected at one works only in 1870, and was found to be a failure; after running a year or two it was entirely reconstructed to burn fuel. Since then the mechanical bogies and engine gearing have been completely altered, so that the figures can hardly be said to represent one of the "most modern constructions."

Regarding chimney power Dr. Lunge says (p. 412) that usually every two revolvers have a chimney 6 feet diameter and 100 feet high to themselves. This is certainly not sufficient for the most economical working; to stint a revolver of draught is a serious mistake.

On another point in the black-ash process Dr. Lunge's opinions do not tally with those of Lancashire manufacturers. A few years ago Mr. Mactear of St. Rollox proposed a plan of adding from 6 to 10 per cent. of lime to the black-ash in excess of that usually worked. This apparently simple process was believed by some likely to work wonders, and statements were made as to the actual gain of many thousands of pounds per annum in a single works by its adoption. Dr. Lunge gives more credit to this than some of our Lancashire friends seem inclined to do.

The remaining processes in the great suite of chemical changes involved in the alkali trade are as thoroughly discussed by Dr. Lunge as those which have now been noticed. Divergent views concerning many details of these may doubtless be held by various manufacturers, but all will agree in the opinion not only that this is an excellent book, but that it would be very difficult for any one to write a better one.

H. E. ROSCOE

#### THE FLORA OF PLYMOUTH

*Flora of Plymouth: an Account of the Flowering Plants and Ferns found within Twelve Miles of the Town, with Brief Sketches of the Topography, Geology, and Climate of the Area and History of Local Botanical Investigation.* By T. R. Archer Briggs, F.L.S. With Map. 8vo, pp. xxxv. and 432. (London: Van Voorst, 1880.)

THIS is a model local flora. Mr. Briggs is well known as one of the most experienced and trustworthy amongst the botanists who have made a special study of British Phanerogamia. He has established a claim upon the gratitude of his fellow-workers by acting for several years as the honorary distributor of their Exchange Club, and in this capacity has received and sent out many thousands of specimens. The present work is the result of the rambles of twenty years, and as he has restricted its limits to a radius of twelve miles from the town, the whole of the district has been within walking distance of his home, and it is probable that there is no tract in Britain of which the plants have been worked out and placed on record in such a thorough and exhaustive manner. A radius of twelve miles from Plymouth includes a great variety of soil and situation. There are the maritime plants of the seashore and the tidal reaches of the Tamar and its affluents. Inland there are in the low country besides the stream-sides, meadows, and cultivated fields, plenty of woods and deep shady lanes with high banks and thick hedgerows, and the twelve miles radius reaches to a height of 1,700 feet on Dartmoor, and includes a considerable space of open uncultivated heathy and swampy ground. The district is not rich in limestone nor in ponds, but except in the plants which affect these two kinds of station there is full scope so far as situation goes to suit all their varied requirements in habitat.

Out of the 1,680 species enumerated in the last edition of the London Catalogue 873, or considerably more than half, are found within the radius covered by this book. Out of these 728 are natives, and the other 145 more or less certainly introduced by human agency.

It is interesting to have an area so far west in the island so thoroughly worked out, and certainly one of the most instructive points in connection with the matter is to note which British plants fail to reach and become very rare within the area. Taking the species according to their types of distribution as classified by Mr. Watson in the fourth volume of his "Cybele Britannica," and adopting the more stringent scale of species-limitation which he there follows, we find that out of 1,425 British species 764 grow in the neighbourhood of Plymouth. The 120 species of Watson's highland or extreme northern type and the 49 local or doubtful species are not represented here at all. Of the eighty-one species of his Scottish type we get only 5, and out of the 37 species of his intermediate type only 3 enter into the Plymouth area. So that the boreal element of the British flora, 238 species, is represented at Plymouth only by 8 species, such plants as *Rubus saxatilis*, *Gnaphalium dioicum*, *Polyodium Phegopteris*, *Polyodium Dryopteris*, and *Lycopodium Selago* lurking in very small quantity in the recesses of Dartmoor. Of Watson's 70 Atlantic or specially western species Plymouth has 36; of Watson's 127 Germanic or specially eastern species Plymouth has only 16; of the 532 species spread almost universally through Britain Plymouth has 484. Perhaps the most noteworthy point of all is that of Watson's 409 plants of the English type of distribution, plants spread widely through England, but running out in a northern direction north of the Humber and in the Scotch Lowlands, Plymouth gets only 220, or little more than half. Amongst the absentees in widely-spread English plants, for instance, are the common Forget-me-not (*Myosotis palustris*), the Mistletoe, *Genista tinctoria*, *Veronica Anagallis*, *Glyceria aquatica*, and *Scirpus lacustris*; and amongst the great rarities the common harebell (*Campanula rotundifolia*), the cowslip, the common butter-bur, *Hieracium boreale* and *vulgatum*, and some of the common south-country weeds, like *Solanum nigrum* and *Mercurialis annua*, which round about London are exceedingly plentiful. In the critical genera of British plants Plymouth is rich in rubi and roses, very poor in willows and hieracia. Amongst the rarities of the neighbourhood are *Poly-carpon tetraphyllum*, *Eryngium campestre*, *Pyrus Briggii*, a curious pear with fruit like that of a small crab-apple, *Physospermum cornubiense*, and two species of *Hypericum*, *beticum*, and *linariifolium*, and it produces some curious hybrid epilobia and rumices.

The area is divided into five districts, founded on river-drainage, two of which are in Cornwall and three in Devonshire; and under these the special localities of the species are carefully traced out, the abundance in which each occurs being particularised, and the claims of each to be regarded as wild being in all doubtful cases carefully investigated.

As stated in the title, the book includes a map and short sketches of the climatology and geology of the district, and of the progress of botanical investigation within its bounds from the days of Lobel and Parkinson down to the present day. We can recommend it with confidence to all our readers who are interested in geographical botany as one of the most complete, conscientious, and interesting works of its kind that have ever appeared.

#### OUR BOOK SHELF

*Peruvian Antiquities: The Necropolis of Ancon in Peru. A Series of Illustrations of the Civilisation and Industry of the Empire of the Incas. Being the Results of Excavations made on the Spot.* By W. Reiss and A. Stübel. (London: Asher and Co., 1881.)

A FIRST instalment now lies before us of this magnificent undertaking, which, if fully realised, bids fair to rival in scientific interest and typographical splendour Lord Kingsborough's great work on Mexican Antiquities. Reserving a full notice for a later stage of the project, it will suffice here briefly to indicate its main features, and direct attention to its paramount importance for antiquarian and ethnological studies. The authors, who have lately returned from South America laden with archaeological treasures of all kinds, have been encouraged by the munificence of the directors of the Berlin Royal Museum to place the results of many years' diligent research at the disposal of the public. Under the general heading of "Peruvian Antiquities" the publishers, Messrs. Asher and Co., of Berlin and London, propose to issue simultaneously in English and German a series of folio volumes illustrating the whole field of the ancient Quichua-Aymara culture, such as it existed at the time of the Spanish invasion. The publication will spread over a number of years, each volume appearing in separate parts varying in number according to the nature of the subject. Each part will contain a number of chromolithographic engravings with corresponding pages of explanatory text. These illustrations, which of course are the great feature of the work, will be produced in the most finished style of modern typographic art, and will consist of perfect facsimiles either in natural or reduced size of every conceivable object associated with the ancient civilisation of the Incas. The series begins with a volume devoted entirely to the "Necropolis of Ancon," now an obscure watering place and fishing village on the Peruvian coast, a little north of Lima, but in pre-Spanish times evidently the centre of a thickly-peopled district that had long been occupied by a settled population. The "finds" made in the mummy graves of this burial-place are of extraordinary archaeological interest, illustrating in the most vivid manner every aspect of the social and domestic life of the ancient Peruvians. The volume is to be completed during the course of the ensuing two years in ten uniform parts, as above described, and to judge from Part I., which has just appeared, it is likely to prove of the utmost value to the antiquary and ethnologist. But our remarks on all details must be postponed till this volume is completed. The English text has been entrusted to Mr. A. H. Keane, whose special knowledge of the subject must ensure accuracy in the descriptive and explanatory part of the work.

*Expose Historique concernant le Cours des Machines, dans l'Enseignement de l'École Polytechnique.* 23 pp. (Paris: Gauthier-Villars, 1880.)

THE council for the improvement of the course of study at the Polytechnic School has for some time had under consideration a revision of the *Programme d'Instruction* of the two years' course, and at different times, for instance in 1865, steps have been taken with a view to their improvement, but, according to this pamphlet, different circumstances, especially in 1870, have deferred the realisation of such schemes. Upon such a wide subject our author does not venture, but he confines himself merely to that part which relates to the *Cours de Machines*. We are indebted for this very interesting and full historical sketch of the matter from the very foundation of the school to the veteran geometer, M. Chasles.